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Conducting Peer Reviews

Presented by: Ella Page

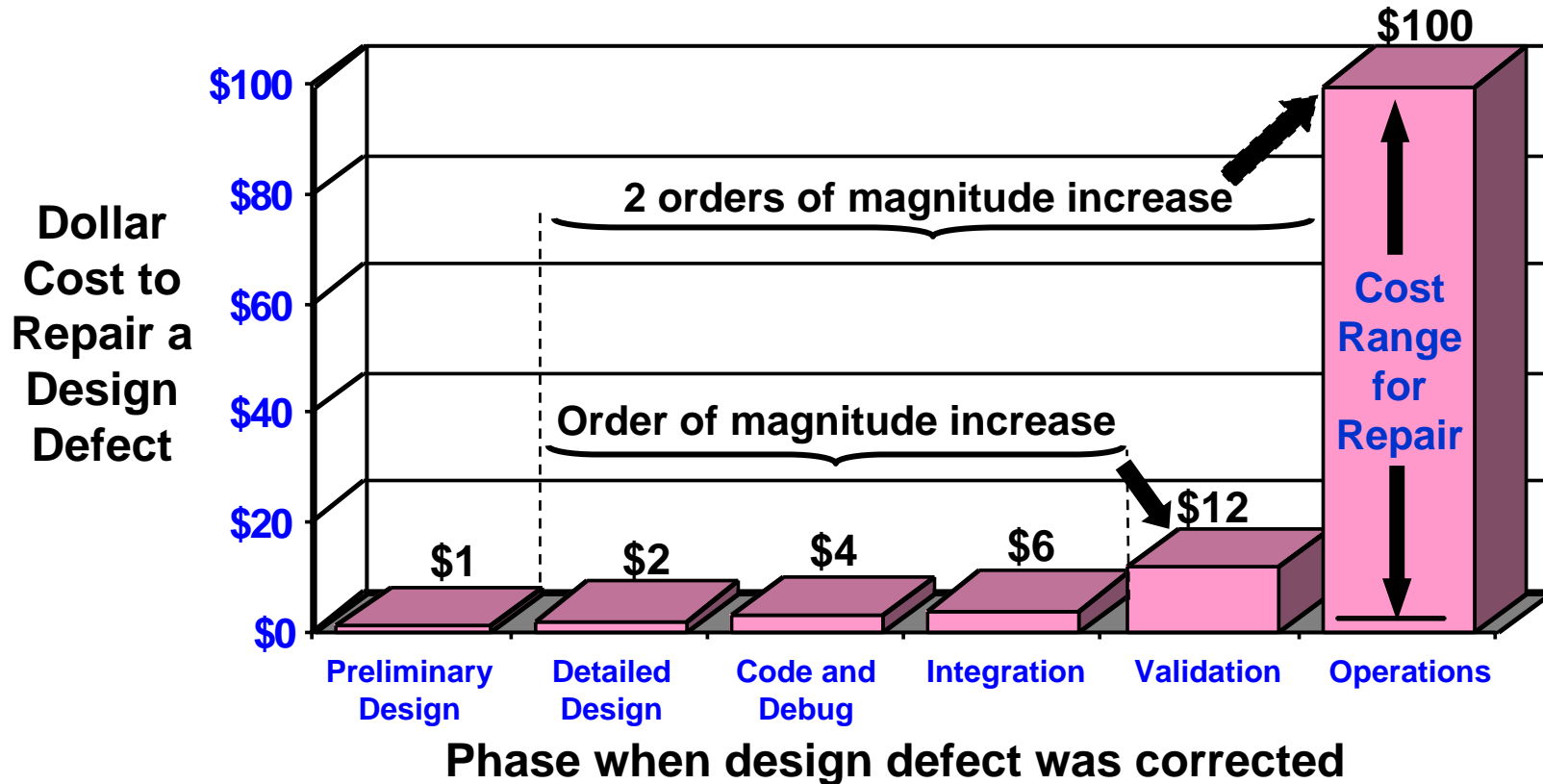### *Software Process Improvement (SPI) Project*

- **Purpose: To provide an understanding of three types of peer reviews and why you should use them**
- **Objective - After this class you should understand:**
  - **The difference between the three types of peer reviews: inspections, walkthroughs, and reading**
  - **Why peer reviews are important to your project**
  - **What items you need to inspect**
  - **How to plan and conduct an inspection**
  - **How to use the tools the SPI group provides**

- **Inspections, Walkthroughs, and reading all have a similar purpose: to provide qualified review and feedback on software work products**
  - **Inspections use visual examination of products to detect errors, violations of standards, and other problems**
  - **In Walkthroughs, a designer or programmer leads developers and other parties through a segment of documentation and code with the focus more on education than finding errors**
  - **In reading, individuals review the product to detect errors, violations of standards, or other problems and communicate results back individually**

- ***The objective is to remove defects as early as possible** in the development process*

- ***Peer reviews follow a structured, well-defined process** for finding and fixing defects*
  - **Conducted by small team of peers with assigned roles**
  - **Each participant has vested interest in work product**
  - **Held within development phases on completed portions of engineering products**

- ***Peer reviews** rely on a shared responsibility **for work product with author's peers***

- ***Peer reviews include checklists or reading techniques** used to improve quality and efficiency of the review process*

Early Detection Saves Time and Money

Dollar Cost to Repair a Design Defect

$100
$80
$60
$40
$20
$0

$100

2 orders of magnitude increase

Cost Range for Repair

Order of magnitude increase

$1
$2
$4
$6
$12

Preliminary Design
Detailed Design
Code and Debug
Integration
Validation
Operations

Phase when design defect was corrected
Source: SEPG Conference, 1999

- **Low Maturity organizations can spend 45-50% of project cost on rework**
- **High Maturity organizations can drive this down below 10%**

Peer Review Benefits Your Team*
* Based on a study across NASA Centers done in 2000

- **Defect detection**
  - **Improves software quality: provides a technically correct base for following lifecycle phases**
  - **Cost savings through early fault detection and correction**
- **Improved communication between developers**
  - **Dissemination of technical information**
  - **Shared ideas and lessons**
  - **Team building: "Knowing who to go to with a question"**
  - **Contribution to project tracking**
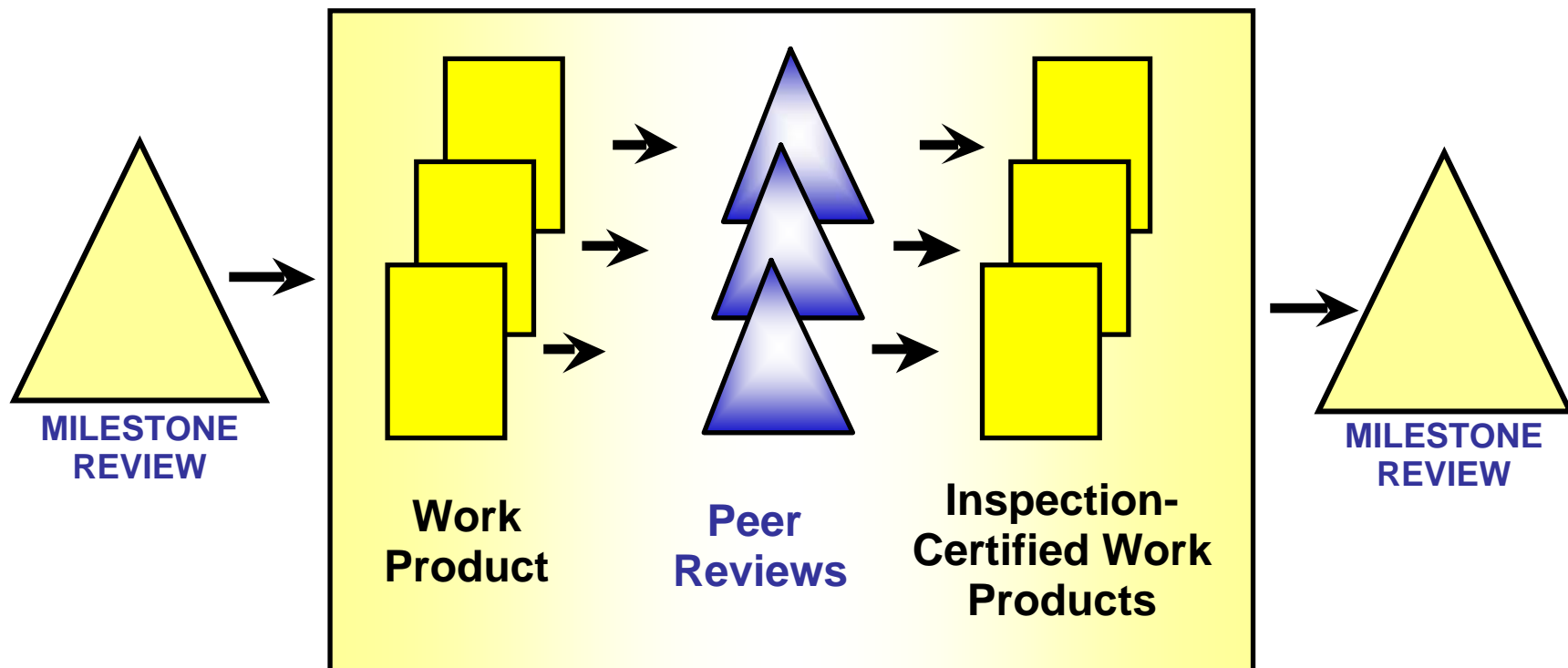- **Process**
  - **Providing structure for in-process reviews**
- **Training**
  - **Aids in the project and technical education of personnel**
  - **Team building, education in project conventions and practices**

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**MILESTONE
REVIEW**

**Work
Product**

**Peer
Reviews**

**Inspection-
Certified Work
Products**

**MILESTONE
REVIEW**

Peer Reviews Complement Milestone Reviews

Source: J. Kelly, 1987

A Comparison of Peer Review Types

	Inspections	Walkthroughs	Reading
Purpose of approach	Defect detection	Communication Defect detection	Defect detection
Defined roles	Included	Optional	Optional
Review material in advance	Required	Optional	Optional
Checklists or reading techniques	Included	Optional	Optional
Manager participation	**Not Allowed**	Optional	Optional
Meeting leader	Moderator	Author	**No meeting held**
Solve problems at meeting	No	Optional	**No meeting held**
Tracking defects to closure	Included	Optional	Optional

Recommended as most effective for defect detection

Inspections and Project Planning

- **To plan inspections, answer these questions**
  1. **What items should you inspect?**

     Which are required? Which are recommended?
  2. **How will you inspect the items?**

     What process? What approach to reviewing?
  3. **Who is involved?**

     Defined as a set of roles for inspections
  4. **How much should be done in each inspection?**

- **Document your answers in your Software Management Plan/Project Plan (SMP/PP)**
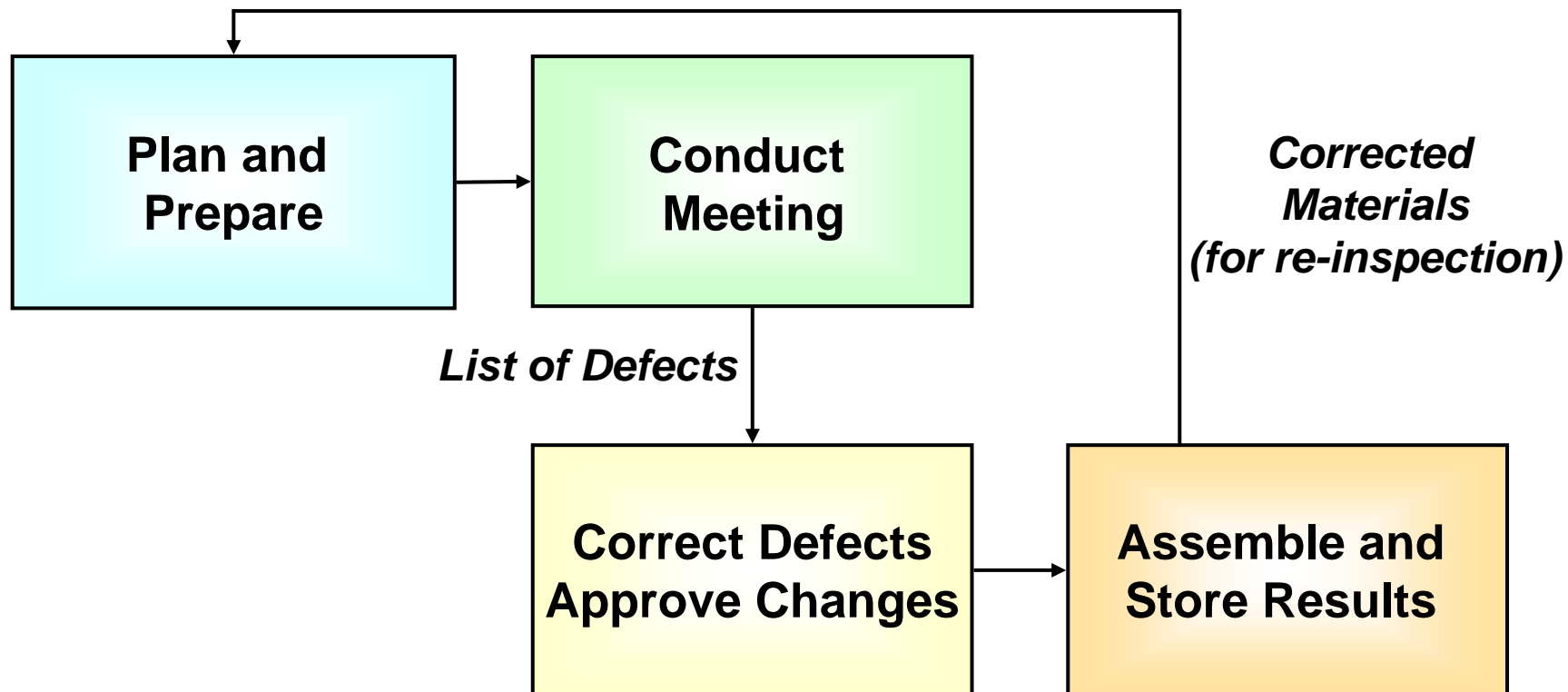 - **In section of "Verification and Validation Strategy"**

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1. What Items Should You Inspect?

■ **You are *required* by NPR 7150.2 to inspect**
  – **Requirements Documentation**
  – **Test Plans**

■ **Other items you *may* review through inspections, walkthroughs, or reading are:**
  – **Architectural and detailed design**
  – **Source code**
  – **Test procedures**
  – **Any other useful documents, such as**
    • **User documentation, SMP/PP, user interface definitions, prototype screenshots, …**

Other Potential Uses for Inspections

- **Possible inspection uses at project level**
  - **Inspections of the life-cycle model**
  - **Inspections of tailoring guidelines**
  - **Inspections of the project's defined process**
  - **Inspections of installation, operation, and maintenance documentation**
- **Possible inspection uses at organizational level:**
  - **Inspections of the organization's set of standard processes**
  - **Inspections of definitions of planned measures and the procedures for collecting, storing, and analyzing measures**

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Plan and Prepare → **Conduct Meeting**

List of Defects

Correct Defects Approve Changes → **Assemble and Store Results**

Corrected Materials (for re-inspection)

Plan and Prepare

1. **Organize and schedule review meeting**
2. **Prepare and distribute meeting announcement**
3. *Review the material and prepare comments**

Conduct Meeting

4. **Conduct the review and record defects**
5. **Determine if re-review is needed**

Correct Defects Approve Changes

6. *Perform any necessary rework**
7. *Approve the work products and close the review**

Assemble and Store Results

8. *Assemble review package and store in repository**

* These steps are used for Reading

Preparing for an Inspection

The approach we recommend for most projects

- **Checklist-Based Inspection**
  - **Reviewers are given a checklist of issues to look for based on a set of desirable properties**

- **Perspective-Based Inspection**
  - **Reviewers represent how different stakeholders would use item being inspected**

- **Defect-Based Inspection**
  - **Reviewers are given a list of defect types to look for**

- **Ad hoc Inspection**
  - **Turn an expert loose and let her (or him) find the problems**

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Inspection Checklist Assets*

- **Inspection Checklists**
  - **Requirements Peer Review Checklist**
  - **Design Inspection/Walkthrough Checklist**
  - **Code Inspection Checklist**
- **These checklists can also be used for walkthroughs and reading**

* http://software.gsfc.nasa.gov/assetsbytype.cfm?Type Asset=Checklist

- **Moderator**
  - **Coordinates and conducts the inspection process**
  - **Tracks defect corrections and open issues to closure**
  - **Certifies completion of rework**
- **Author**
  - **Produces the work product and performs rework**
- **Scribe**
  - **Records defects identified during the inspection meeting**
- **Reviewers**
  - **Reviews the work product and provides comments**
    - **Comments can be sent out in advance or brought to meeting**
  - **Should include representation from all relevant stakeholders**
- **Reader (often is done by author)**
  - **Presents the work product to the inspection team during the inspection meeting**

4. How Much Should Be Done In Each Inspection?

Recommended Range of Inspection "Size"

Inspection Type	Target*	Range*
Functional Design	20 Pages	10 to 30 Pages
Software Req.	20 Pages	10 to 30 Pages
Arch. Design	30 Pages	20 to 40 Pages
Detailed Design	35 Pages	25 to 45 Pages
Source Code**	500 LOC	400 to 600 LOC
Test Plans	30 Pages	20 to 40 Pages
Test Procedures	35 Pages	25 to 45 Pages

- **Use this information as part of your cost estimation**
- **Notes:**
  - *** Based on two hour inspection meeting**
  - **** Highly complex code (like flight software) should proceed at approximately half this rate**

Further Planning Considerations

- **General**
  - **If you use reading without inspection or walkthrough, make sure you have more than 1 reviewer**
  - **If added work is needed to understand product under review, you can hold an overview meeting before the inspection**
  - **You can hold a "third hour" meeting to work problems as a team**
- **Small projects**
  - **Inspectors may need to be found from outside the team**
  - **You can combine roles, except the moderator can't be the author or reader**
- **Large projects**
  - **Moderators may specialize, e.g., GN&C expert may moderate all inspections for attitude control software**

- **The example is for a requirements inspection**

- **The example uses SPI tools***
  - **Inspection Moderator Tool to:**
    - **Meet NPR 7150.2 requirement on inspection reports**
    - **Create an inspection report for each inspection**
  - **Inspection Metrics Tool to:**
    - **Store summary data on all the inspections you carry out**

* http://software.gsfc.nasa.gov/tools.cfm

Plan and Prepare for the Meeting

Plan and Prepare
1. Organize and schedule review meeting
2. Prepare and distribute meeting announcement
3. Review the material and prepare comments

Conduct Meeting
4. Conduct the review and record defects
5. Determine if re-review is needed

Correct Defects Approve Changes
6. Perform any necessary rework
7. Approve the work products and close the review

Assemble and Store Results
8. Assemble review package and store in repository

- **Step 1: Organize and Schedule Review Meeting**
  - **Identify participants**
    - **Make sure all relevant groups are represented**
  - **Schedule meeting and reserve room**
    - **Confirm that everyone can make it and assign roles**
- **Step 2: Prepare and Distribute Meeting Announcement**
  - **Verify that material is ready for review**
  - **Distribute review materials**
    - **Give at least three business days notice**
    - **Most of these products should be online**

■ Step 3: Review Materials and Prepare Comments

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- **When reviewing the work product, use**
  - **The work product itself**
  - **The checklist or reading technique**
  - **Related reference material**
- **As you read, record issues to bring to the meeting**
  - **On a hardcopy of the product being inspected**

or

  - **In a copy of the Inspection Moderator Tool**
- **Record the amount of time you spent and bring to the meeting**

Data Preparation for the Inspection Moderator Tool

PREPARATION

Item inspected:	Real-Time Attitude Requirements	
Author:	Pete	
Inspection type:	Requirements	
Review Date		7-Jul-07
Meeting Time:		2:00 PM
Total Prep. time		0

Record the schedule information

Name	Role / Stakeholder affiliation	Prep hours	Attended?
John	Moderator		
Pete	Author		
Keith	Sensor expert		
Roger	Kalman Filter expert		

Lists participants:
- *To make sure right people are participating*
- *To record preparation time (tool computes total)*

- ## Step 4: Conduct Review and Record Defects

  - **If reviewers aren't prepared, postpone the meeting!**
  - **Review the work product**
    - **Focus on the product, not the author**
    - **Reader steps through in logical order**
      - **Participants raise issues the review progresses**
      - **Agree as a group which comments are defects**
    - **Record agreed-to defects (but don't fix them during the inspection meeting)**
  - **At the end of the meeting**
    - **Complete the "Meeting" section of the Inspection Moderator Tool**

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Inspection Moderator Tool: Meeting Data

Name	Role / Stakeholder affiliation	Prep hours	Attended?
John	Moderator	5	x
Pete	Author	0	x
Keith	Sensor expert	2	x
Roger	Kalman Filter expert	1	x

Record preparation hours and attendance

	MEETING			
ID	Defect Description	Disposition	Defect Severity	Defect Type
1	Requirements don't address what happens if star camera fails	Opened	Moderate	omission
2	Sign error in propagation of quaternion	Opened	Major	error
3	Sometimes term "state vector" is used, sometimes "attitude", and sometimes "quaternion and angular velocity".	Opened	Major	amgiguity
4	On p.3 it calls for 10 arc second accuracy, on p. 5 it calls for 30 arc second accuracy. Which is correct, and are both needed?	Opened	Minor	redundancy

Total # of defects	4

Meeting Length:	1.5
Number of attendees:	4
Meeting effort	6

Record length of meeting at the end

Describe defects and provide related data

- **Disposition: Initially, put disposition as "Open"**
- **Type (for requirements): Omission, Error, Ambiguity, Redundancy**
- **Severity: Major, Moderate, Minor**

Step 5: Determine If Re-Review Is Needed

- At the end of the meeting, decide if the product passes inspection or if re-inspection is needed
- Either way, the author will correct defects before the next stage
  - Re-inspect if:
    - Pre-established guidelines have been met
      (e.g., JPL's guideline of 25% or more needs to be fixed)
    - Large numbers of major defects are found
    - Major defects occur in critical sections of the product
    - "Engineering Judgment" says so
- Schedule any re-inspection before leaving the meeting
  - Allow about 2 weeks for corrections and second reading by reviewers

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Correct Defects and Approve Changes

- **Step 6: Perform Necessary Rework**
  - **Make correction and recommend it to be closed**
  - **Recommend it to be withdrawn if it isn't really a defect (but author must convince moderator!)**
  - **Recommend it to be deferred and treated as action item if waiting on needed information**

- **Step 7: Approve Work Products and Close Review**
  - **Assure that no defects are left open**
  - **Verify that changes are correct**
  - **Concur with all dispositions**
  - **Approve result of rework if it is all satisfactory**
    - **Moderator decides if re-inspection is needed at this point, even if inspection originally passed**

Plan and Prepare
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Inspection Moderator Tool: Post-Meeting Data

ID	Defect Description	Disposition	Defect Severity	Defect Type
1	Requirements don't address what happens if star camera fails	Deferred	Moderate	omission
2	Sign error in propagation of quaternion	Closed	Major	error
3	Sometimes term "state vector" is used, sometimes "attitude", and sometimes "quaternion and angular velocity".	Closed	Major	amgiguity
4	On p.3 it calls for 10 arc second accuracy, on p. 5 it calls for 30 arc second accuracy. Which is correct, and are both needed?	Closed	Minor	redundancy

Total # of defects	4
Meeting Length:	1.5
Number of attendees:	4
Meeting effort	6

POST-MEETING

Author effort to correct defects	2
Moderator effort to review corrections	0.5
Total post-inspection effort	2.5
Outcome (pass or re-inspect)	pass

Record the disposition of defects

Record the moderator and author post-meeting effort and outcomes of inspection

Plan and Prepare
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Conduct Meeting
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■ **Collect all of the records**
  – **Complete inspection report (using Inspection Moderator Tool)**
  – **Update inspection metrics (using Inspection Metrics Tool or Branch Status Review charts)**
    • **"Box Score" is found to right of preparation data in Inspection Moderator Tool**
    • **Copy and Paste Special / Value to store metrics**
  – **Either transfer deferred corrections to action item tool or manage them using inspection tools**

■ **Store the records for the inspection**

Mechanics of Storing Metrics

# Planned Meetings	
# Actual Meetings	

Item Inspected	Author	Review Date	Total Effort	Meeting Length	Number Attendees	Defects Number Found	Defects Number Corrected	Defects Number Deferred	Inspection Type	Action Items Open Actions	Action Items Closed Actions
Star camera reqts.	Bruce	6/8/2007	15	3	3	8	8	0	Requirements	0	0
Reaction Wheel Requirements	Bono	6/26/2007	17	2	4	5	3	2	Requirements	2	0
Gyro Requirements	Madonna	7/3/2007	12	1.5	4	2	2	0	Requirements	0	0

Inspection Metrics Tool

Item	Author	Date	Effort	Length	Attendees	Found	Corrected	Deferred	Inspection Type	Open Actions	Closed Actions
Real-Time Attitude Algorithms	Pete	7/7/2007	16.5	1.5	4	4	3	1	Requirements	1	0

"Box Score" from Moderator Tool

# Planned Meetings	
# Actual Meetings	

Item Inspected	Author	Review Date	Total Effort	Meeting Length	Number Attendees	Defects Number Found	Defects Number Corrected	Defects Number Deferred	Inspection Type	Action Items Open Actions	Action Items Closed Actions
Star camera reqts.	Bruce	6/8/2007	15	3	3	8	8	0	Requirements	0	0
Reaction Wheel Requirements	Bono	6/26/2007	17	2	4	5	3	2	Requirements	2	0
Gyro Requirements	Madonna	7/3/2007	12	1.5	4	2	2	0	Requirements	0	0
Real-Time Attitude Algorithms	Pete	7/7/2007	16.5	1.5	4	4	3	1	Requirements	1	0

Updated Inspection Metrics

Monitoring and Controlling Inspections

- **Periodically monitor peer inspection results**
  - **Look closely at inspections with extremely low number of defects found (finding defects during inspections is a good thing)**
  - **Look closely at inspections with extremely high number of defects found (was it the review process or the product)**
  - **Deferred defects indicate lack of information needed to complete corrections (maybe you need stakeholder communication)**

- **Control the inspection process**
  - **Not holding planned meetings may indicate lack of preparation time, or key players not being available**
  - **Keep meetings under two hours; people zone out and are less effective after that point**

Reporting Status for Inspections

# Planned Meetings	4
# Actual Meetings	2

Item Inspected	Author	Review Date	Total Effort	Meeting Length	Number Attendees	Defects			Inspection Type	Action Items	
						Number Found	Number Corrected	Number Deferred		Open Actions	Closed Actions
Reaction Wheel Requirements	Bono	6/26/07	17	2	4	5	3	2	Requirements	2	0
Gyro Requirements	Madonna	7/3/07	12	1.5	4	2	2	0	Requirements	0	0
Real-Time Attitude Algorithms	Pete	7/7/07	16.5	1.5	4	4	3	1	Requirements	1	0

Analysis: Two inspection meetings were not held, due to lack of GN & C representation. We are also still waiting for answers to questions on reaction wheels from last month's inspections.
Impact: The requirements have sufficient information to implement from, but at increased risk of rework during testing.
Corrective Action: Add this issue to the action item list, continue to track until closed.

- **In reporting inspection status**
  - **Include inspections held during the current reporting period**
  - **Include previous inspections if action items remain**
  - **Hide all other rows**
- **Approach to analysis, impact and corrective action is same as for other measures**
  - **Look for extreme values or deviations from expectations**

- **Defect counts by type**
  - **Data is in hidden rows below red line in Inspection Moderator Report**
  - **Look to see if you are prone to particular kinds of errors (e.g., omitted requirements)**
- **Phase containment**
  - **Use inspection data and problem report data**
  - **SPI Problem report tool allows tester to identify source of error (requirements, design, code,…) for each problem**
  - **Ideal is to see all errors removed from products right away, not identified in later phases**

- **Tools**
  - **SPI Tools: Inspection Moderator Tool*, Inspection Metrics Tool***
  - **Other NASA Tools: Inspec, eRoom**
  - **Checklists**
- **Work Products**
  - **Inspection Reports**
  - **BSR slides on inspections measures**
  - **e-mails: announcements, discussions of issues found, moderator signoff on corrections,…**
  - **SMP/PP section on Peer Reviews**

* http://software.gsfc.nasa.gov/tools.cfm

- **Products of the peer review process that should be kept in your project data stores:**
  - **Peer review minutes with attendees, what was reviewed, and outcome**
  - **Peer review checklists used**
  - **Selected work products reviewed**
  - **Peer review results**
  - **Peer review issues**
  - **Peer review data**
  - **Peer review action items**
  - **Any additional reviews required**

- **Make sure all peer review participants have received some peer review training and understand the process**
- **Stay focused on review of the product and not on the product developer**
- **Make sure you document *and communicate* issues identified during the review**
- **Schedule a follow-up review to address issues when warranted**
- **Post review schedules early to ensure the appropriate attendees are available**
- **Avoid the last-minute review by distributing products early enough for review prior to the inspection meeting**
- **Make sure ground rules (entry/exit criteria, checklists) are defined prior to inspections**

Peer Review Summary

- **Inspections and walkthroughs are**
  - *Very* **cost-effective**
  - **Required for requirements documents and test plans**
  - **Can be used to review any product**
- **Make sure relevant stakeholders are represented**
- **Use the checklists that highlight types of errors to look for**
- **Limit inspection meetings to two hours**
- **Use metrics to**
  - **Track product quality**
  - **Control the inspection process**
- **Use tools to save results of inspections**

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REMEMBER:

"Inspections are the single most cost-effective method for process improvement"

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Questions?

Acronyms

- **BSR – Branch Status Review**
- **GN&C – Guidance, Navigation, and Control**
- **NPR – NASA Procedural Requirement**
- **SEPG – Software Engineering Process Group**
- **SMP/PP – Software Management Plan/Product Plan**
- **SPI – Software Process Improvement**